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SO-ITF-SM-23

Terminalia catappa L. Indian Almond, Almendra

Combretaceae Combretum family

SO-ITF-SM-23
October 1989

John K. Francis

U.S. Forest Service
Pacific Southwest Library and Information Center
1323 Club Drive
Vallejo, CA 94592-1110

Indian almond (*Terminalia catappa* L.) is planted as an ornamental throughout the world in tropical countries at low elevations because it is both hardy and attractive (fig. 1). The tree produces an edible seed and beautiful wood, although it is little exploited for lumber.

HABITAT

Native Range

Indian almond is native to coastal areas of eastern India, the Andaman Islands, Indochina, Malaysia, Indonesia, northern Australia, Oceania, the Philippines, and Taiwan (*2, 14, 26, 27, 28,* fig. 2). This area lies between 23° N. and 20° S. latitude and 85° E. and 170° E. longitude. The species is also widely planted and naturalized in lowland tropical regions in the rest of the world (*16, 22, 30*).

Climate

Indian almond grows best in a moist tropical climate (*31*). Experience in Puerto Rico indicates that it will survive with as little as 750 mm precipitation. Best growth seems to occur in areas receiving more than 1500 mm precipitation. The species loses its leaves twice a year in most areas with a brilliant red and yellow display of leaf color before doing so (*8*). Leaf loss helps it tolerate one or two annual dry seasons where they occur. Year-round warm temperatures are best, but Indian almond easily tolerates cool winter temperatures. Its distribution in southern Florida would indicate that it can withstand light, occasional frosts (*4*).

Soils and Topography

Although Indian almond does grow when planted on uplands (*6, 27*), the natural habitat of the species is in areas just inland from ocean beaches, near river mouths, and on coastal plains (*1, 32, 33*). These areas are typically flat, but they may have dunes or rocky bluffs. The species grows in the greatest concentration on sands and loamy sands (*14*), and when disturbance allows it to dominate competing vegetation, it does very well on silts, loams, and clays. Soil pH's are usually neutral to moderately alkaline and rich in bases. However, it will also grow in strongly acid soils. Good drainage is required on clay soils (*23*).

Associated Forest Cover

In the beach forests of the Andaman Islands, Indian almond is associated with *Mimusops littoralis* (Kurtz) Dubard, *Thespesia populnea* (L.) Sol ex Correa, *Hibiscus tiliaceus* L., *Morinda citrifolia* L., *Erythrina indica* Lamk., *Sterculia* spp., *Pongamia glabra* Vent., *Gyrocarpus jacquini* Roxb., *Calophyllum inophyllum* L., and *Barringtonia speciosa* Forst. (*14*). Another association given for the Andaman Islands beach forests in which Indian almond grows consisted of *C. inophyllum, Afzelia bijuga* A. Gray, *T. populnea, Heritiera littoralis* Dry., *E. indica, Sterculia* spp., *P. glabra, Lannea grandis* Engler, *Hibiscus tiliaceus* L., and *Pandanus odoratissimus* L. (*31*). A natural forest stand in Samoa where Indian almond was growing contained the following species: *Sideroxylon* spp., *Alphitonia zizyphoides* (Spreng.) A. Gray, *Chariessa samoensis, Canagium odoratum* (Lam.) Baill., *Rhus taitensis, Reynoldsia* spp., *Planchonella carberi,* and *Syzygium* spp. (*19*). A *Barringtonia* spp. association, which contains Indian almond, was reported as being typical of the whole Malaysia-Pacific area (*33*).

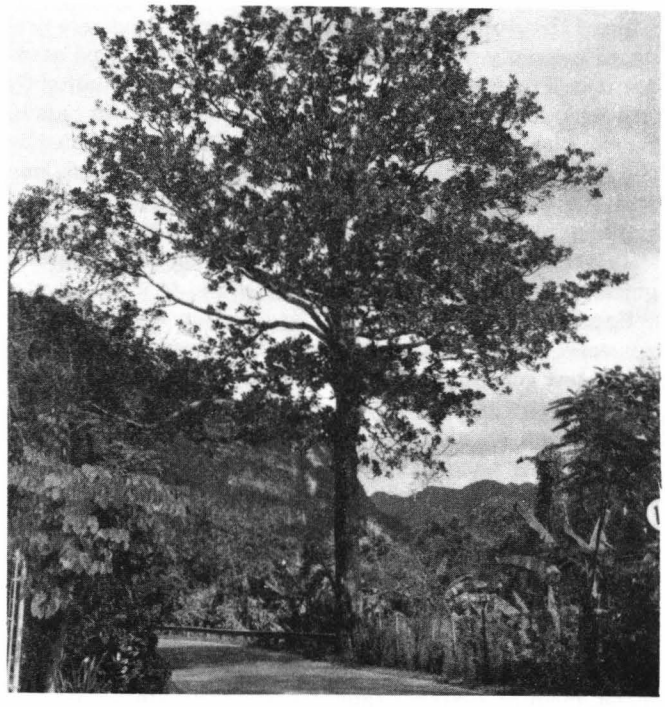

Figure 1.—*A large Indian almond* (Terminalia catappa) *growing in Puerto Rico.*

John K. Francis is research forester at the Institute of Tropical Forestry, Southern Forest Experiment Station, USDA Forest Service, Rio Piedras, Puerto Rico, in cooperation with the University of Puerto Rico, Rio Piedras, PR.

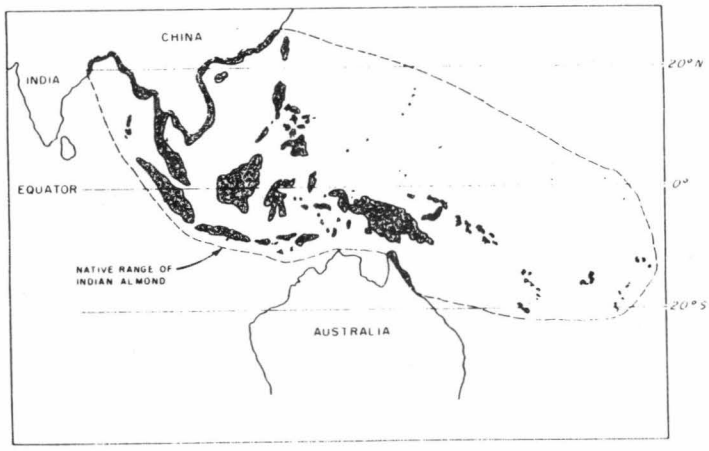

Figure 2.—*Native range of Indian almond* (Terminalia catappa) *in Indo-Malaysia and Oceania.*

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Flowering and fruiting begin at an early age (*30*) and continue annually thereafter. The season of flowering and fruiting varies considerably among both trees and localities. The flower clusters (racemes or spikes) are 5 to 15 cm long, with small, mostly male flowers and a few bisexual flowers near the base (*5, 16*). The fruit is flattened, egg-shaped, 2.5 by 6 cm (*6*), and yellow or reddish when ripe. The cylindrical seeds are encased in a tough, fibrous husk within a fleshy pericarp. There are about 24 fresh fruits (*18*), 160 nuts (*10*), and 780 shelled seeds (*14*) per kilogram.

Seed Production and Dissemination.—Seeds are produced annually (*30*), with a few to several hundred seeds per tree. The fruits are eaten and the seeds distributed by fruit bats in Sabah (*21*) and birds and possibly fruit bats in Puerto Rico. In Calcutta, most of the fruits are consumed by the large parakeet (*Psittacula eupatria*) before people can gather them (*5*). The seeds are specialized for flotation and can apparently cover considerable distances over seas and still remain viable (*8*). Seeds for planting are generally gathered beneath mature trees.

Seedling Development.—Germination of the seed is epigeous. About 70 percent of the ripe seeds in a Puerto Rican test germinated in about 20 days (*18*). The soil used for direct sowing, an often-used means of establishing Indian almond, should be cultivated (*14, 30*). Artificial regeneration using nursery seedlings is more reliable. Seedlings can be raised under either partial shade or full sunlight, and according to one author (*14*) will be ready to outplant in about 1 year. However, a test in Puerto Rico showed the best growth under shade. Shaded seedlings grew to a 68-cm height in 3 months. A plantation of transplanted wildings in Puerto Rico had a survival of 34 percent after 1 year. Although bare-rooted seedlings are probably suitable for moist, medium-textured soils, containerized stock are probably more suitable for sands and loamy sands. Under favorable conditions (i.e., seed present, sufficient moisture, and moderate or low competition), natural regeneration is satisfactory (*14*). Although seedlings develop slowly at first (*30*), growth soon accelerates so that the species has the reputation of being a fast-growing tree (*1*).

Vegetative Reproduction.—Indian almond will coppice as a seedling or sapling, but the species is not a strong sprouter. No other vegetative regeneration, natural or artificial, has been reported.

Sapling and Pole Stage to Maturity

Growth and Yield.—The growth rate of Indian almond has been poorly studied. In a species trial in Western Samoa, a mean height of 16 m and a mean diameter of 19 cm were reached at 9 years (*10*). Although a few very large individuals are known, most Indian almond trees in Puerto Rico reach only a 15- to 25-m height. Height growth during the pole stage is about 1 m/yr, and diameter growth is usually about 1 cm/yr through most of the tree's life. Indian almond trees grown as ornamentals normally live for about 60 years (*23*). On good sites, individuals can reach 30 m in height and 1.2 m in diameter (*14*). The boles ae usually straight, with commercial lengths of 8 to 10 m (*28*).

No guidelines for spacing and management are available. Initial spacings of 3 by 3 m, with thinnings at 10 to 15 years for roundwood products, are suggested until better information is reported. Sawlog rotations between 30 and 45 years are probably realistic.

Rooting Habit.—The species is normally deep rooted on sand. Sometimes shallow lateral root systems develop in response to shallow water tables, and this can lead to windthrow (*35*). A mildly buttressed trunk makes it advisable not to plant too near sidewalks, curbs, or foundations (*29*). The species is known to form natural root grafts (*24*).

Reaction to Competition.—Reproduction is seen nearly everywhere seed is produced, but establishment and integration into the forest canopy is infrequent except on the coastal sands where the species has a competitive advantage (*12, 14, 27*). The species appears to have an intermediate tolerance to shade (*14*). In Puerto Rico, it acts as a successional species establishing under decadent coconut groves. Six plots in five such stands in Puerto Rico averaged 39 ± 5 m^2/ha total basal area, 28 ± 4 m^2/ha of which was Indian almond.

Damaging Agents.—Indian almond appears to be susceptible to defoliating insects, especially when young (*6*). Grasshoppers and beetles are especially troublesome in Malaya (*8*). The most serious pest in Puerto Rico is a thripid, *Selenothrips rubrocinctus* (Giard), which causes leaf discoloration and premature defoliation of adult trees (*20*). Indian almond is listed as being very susceptible to attack by the West Indian dry-wood termite, *Cryptotermes brevis* (Walker) (*34*). The sapwood is susceptible to attack by *Lyctus* spp. (*11*). Based on related species, Indian almond wood is probably quite susceptible to marine borers (*17*). Puerto Rican tests of untreated stakes indicated an intermediate durability (*9*). On the other hand, another observer cautions that the wood is not durable when exposed or in contact with the ground (*28*). Many, but not all, trees in the path of hurricanes are windthrown or suffer severe breakage (*35*). Heavy pruning by wind or humans may weaken or kill mature trees (*1*). Indian almond trees are also damaged by air pollution (*15*).

SPECIAL USES

The principal value of Indian almond is as an ornamental and shade tree. It is favored for the brilliant color of its foliage prior to dropping its leaves, for the tiered symmetry of its branches and its pleasing form, and because it will grow on a wide variety of soils and fill dirt (*29*). It is especially favored near the ocean because it withstands salt spray (*16*).

A secondary value of Indian almond is for the nuts (seeds) they bear. These seeds, eaten raw or roasted, have a flavor similar to almonds (*8*). They contain an edible oil, with an excellent flavor, that makes up about 55 percent of the seed's weight (*22*). The nuts are not exploited on a large scale because they are difficult to crack. The pericarp of at least some varieties is sweet and edible (*5*).

The wood is an attractive yellow-brown to red color but is not extensively used because it is not available in large quantities. It seasons rapidly, with 4.5-percent radial and 5.7-percent tangential shrinkage (*7*). Puerto Rican samples had a moderate amount of warp but almost no checking (*17*); however, it was necessary to kiln-dry the lumber in India to avoid checking (*14*). The density varies from 0.45 to 0.58 g/cm^3 (*7*). The timber is described as moderately strong (*14*). Indian almond wood has a compression strength of 440 kg/cm^2, a bending strength of 880 kg/cm^2, and a modulus of elasticity of 86,000 kg/cm^2 (*25*). Indian almond wood machines fairly easily and can be used for furniture, cabinetwork, flooring, decorative veneer, and general light construction (*7*). The wood of almost all *Terminalia* species is not easily penetrated by preservatives (*11*).

The bark and nuts are used to a limited extent for tannery (*13, 27*). The leaves and bark yield a black dye, and the foliage is used as feed for "tasar" silk worms (*12*). In a few areas of India, the juice of young leaves is used in the treatment of skin diseases and headaches, and the bark is employed in the treatment of dysentery and jaundice (*5*).

GENETICS

Indian almond in India is often confused with *T. procera* Roxb., but in addition to morphological differences, *T. procera* is an upland tree (*14*). *Terminalia* is a large genus with about 100 species spread throughout the tropics (*3*). Genetic studies and systematic selection are apparently not yet under way.

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